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Systematic imaging magma bodies beneath Cascades volcanoes using receiver function

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Pang, Guanning ; Abers, Geoffrey A. ; Moran, Seth C. ; Thelen, Weston A.

Most eruptions at continental arc volcanoes are proximally supplied from crustal magma reservoirs. However, the depths of these crustal magma systems and their volumes are poorly constrained at most active volcanoes. During the last decade, the U.S. Geological Survey's Cascades Volcano Observatory has upgraded the seismic monitoring networks along the Cascade Arc, with new broadband stations within 10-20 km of the summit of seven volcanoes: Mount Rainier, Mount St. Helens, Mount Hood, Three Sisters, Newberry, Crater Lake, and Mount Shasta. In this study, we take advantage of the improved seismic networks and systematically image seven key volcanic centers using the receiver function technique on broadband stations within 10-20 km from the summits. In most cases, receiver functions identify sharp interfaces at the tops of magma bodies that produce distinctive seismic velocity inversions. We also explore the finite-frequency effects on the converted wavefield from the small (a few kilometers in width and thickness) magma body with spectral-element numerical simulations. Most magma bodies are of sizes comparable to the wavelengths of the signals, so the resulting converted seismic wavefield differs from those from much larger structures. Our results enable a systematic assessment of magma reservoir characteristics of volcanoes across the Cascadia arc.

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